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Lee

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(54) **PROBE MEMBER FOR POGO PIN**

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G01R 3/00 (2006.01)

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CPC ***G01R 1/06722*** (2013.01); ***G01R 1/06738*** (2013.01); *G01R 1/06716* (2013.01); *G01R 1/06733* (2013.01); *G01R 3/00* (2013.01)

(58) **Field of Classification Search**
CPC .. G01R 1/06722; G01R 3/00; G01R 1/06733; G01R 1/06738; G01R 1/06716
USPC 324/755
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,557,213	A *	9/1996	Reuter	G01R 1/06722 324/755.05
6,396,293	B1 *	5/2002	Vinther	G01R 1/06722 324/755.05
6,524,115	B1	2/2003	Gates et al.	
6,703,855	B1 *	3/2004	Wu	G01R 1/06722 324/755.05
7,271,015	B2	9/2007	Okamoto et al.	
7,545,159	B2 *	6/2009	Winter	G01R 1/06733 324/755.05
7,956,627	B2	6/2011	Kasukabe et al.	
2003/0222666	A1	12/2003	Kagami	
2004/0232934	A1 *	11/2004	Sinclair	G01R 1/0466 324/755.05
2007/0128906	A1	6/2007	Kazama et al.	
2008/0020498	A1	1/2008	Okamoto et al.	
2008/0036484	A1 *	2/2008	Lee	G01R 1/06722 324/755.05
2008/0180125	A1 *	7/2008	Lee	G01R 1/06733 324/755.05
2009/0261851	A1 *	10/2009	Zhou	G01R 1/06738 324/755.05

(Continued)

FOREIGN PATENT DOCUMENTS

JP	H0555076	7/1993
JP	H0712846	1/1995

(Continued)

OTHER PUBLICATIONS

Korean Notice of Allowance for Korean Application No. 10-2013-0043097, English translation attached to original, Dated Aug. 22, 2014, All together 7 Pages.

(Continued)

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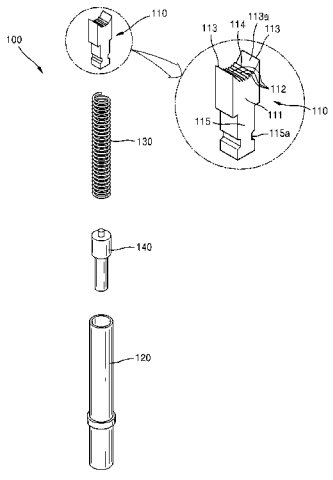
(57) **ABSTRACT**

Provided is probe member for a pogo pin used for testing a semiconductor device, at least a portion of the probe member being inserted into a cylindrical body and supported by an elastic member and an upper end of the probe member contacting a terminal of the semiconductor device.

10 Claims, 10 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2009/0291573	A1	11/2009	Eldridge et al.	
2011/0248736	A1*	10/2011	Kato	G01R 1/06722 324/755.05
2012/0105090	A1*	5/2012	Lee	G01R 1/06722 324/755.05
2012/0187971	A1*	7/2012	Huang	G01R 1/067 324/755.05
2012/0249174	A1*	10/2012	Suzuki	H01R 11/18 324/755.05
2013/0069684	A1*	3/2013	Jeong	G01R 1/06722 324/755.05
2015/0084658	A1	3/2015	Lee	

FOREIGN PATENT DOCUMENTS

JP	H0723284	4/1995
JP	H09320715	12/1997
JP	H10144438	5/1998
JP	H11185912	7/1999
JP	2000123935	4/2000
JP	2000315556	11/2000
JP	2000329789	11/2000
JP	2001337128	12/2001
JP	2002334761	11/2002
JP	2003217774	7/2003
JP	2003344449	12/2003
JP	2008128882	6/2008
JP	2009031111	2/2009
JP	2009139191	6/2009
JP	2010159997	7/2010
JP	2012132717	7/2012
JP	2012181096	9/2012
JP	2014159517	9/2014
JP	2015116465	6/2015
KR	1020050087400	8/2005
KR	1020060127960	12/2006
KR	1020100005535	1/2010
KR	1020110127010	11/2011
TW	200532207	10/2005
TW	200912320	3/2009
TW	I306948	3/2009
TW	201237422	9/2012
WO	2013162343	10/2013

OTHER PUBLICATIONS

Korean Notice of Non-Final Rejection for KR 10-2013-0043097, English Translation attached to original, Completed by the Korean Patent Office, Dated Apr. 14, 2014, All together 13 Pages.

Japanese Office Action for Japanese Application No. JP 2014-159499, Completed by the Japanese Patent Office, Date Jul. 28, 2015, 3 Pages.

* cited by examiner

FIG. 1

- Prior Art -

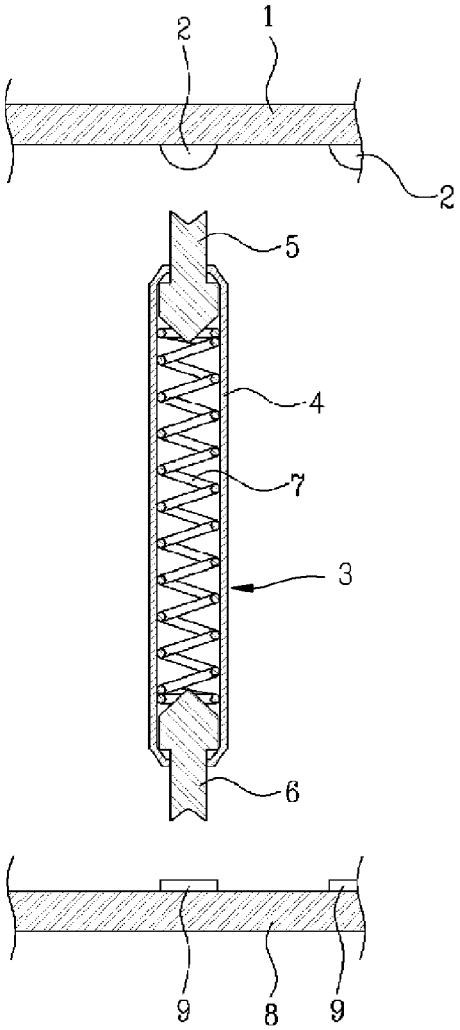


FIG. 2

- Prior Art -

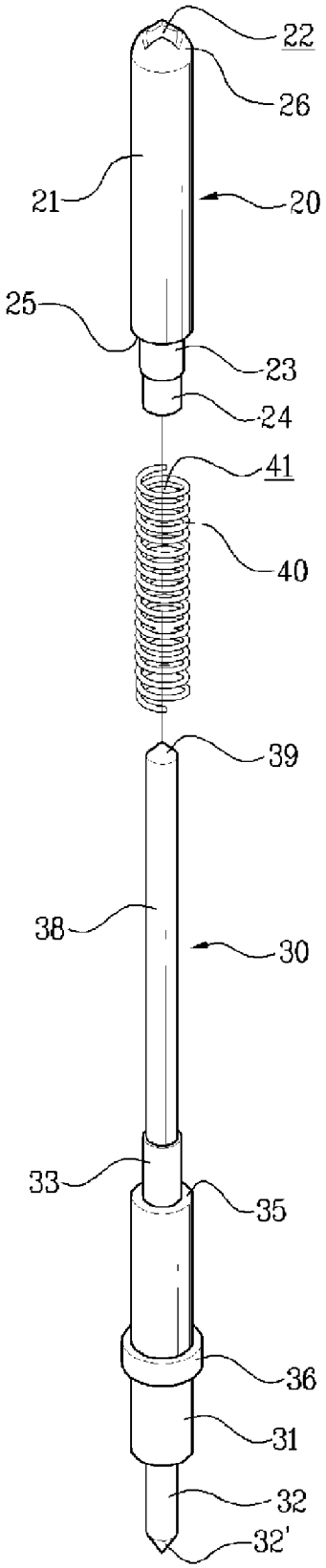


FIG. 3

- Prior Art -

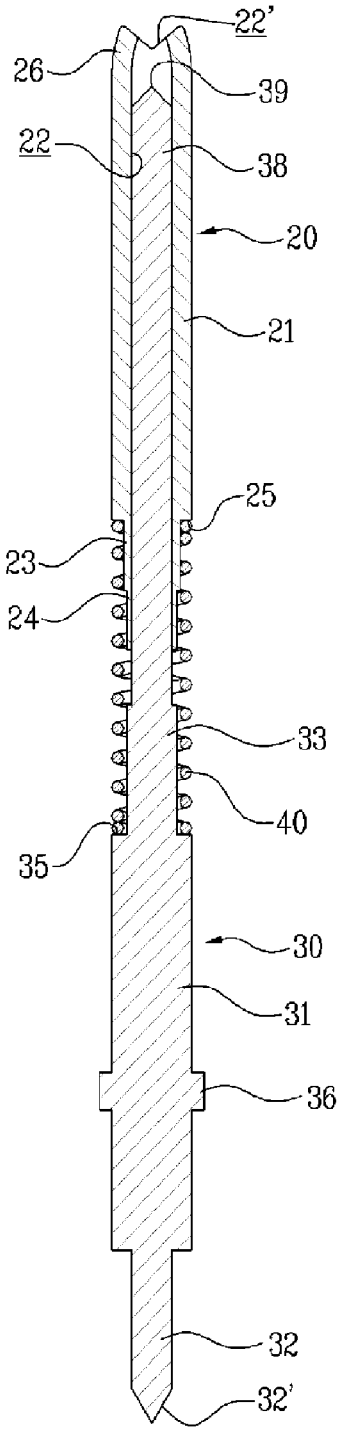


FIG. 4

- Prior Art -

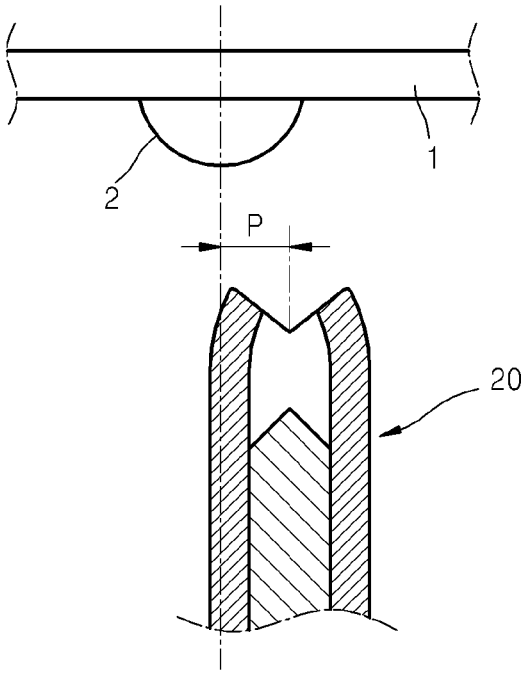


FIG. 5

- Prior Art -

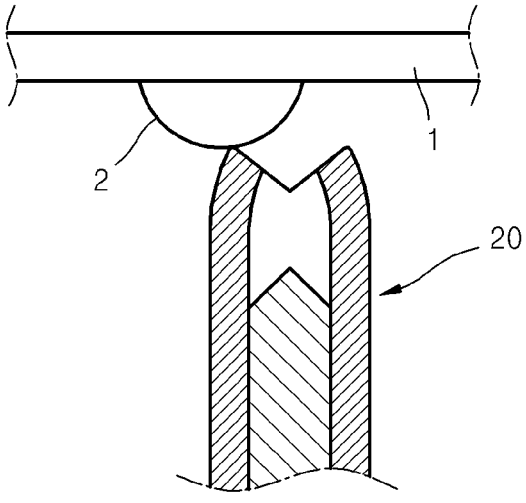


FIG. 6

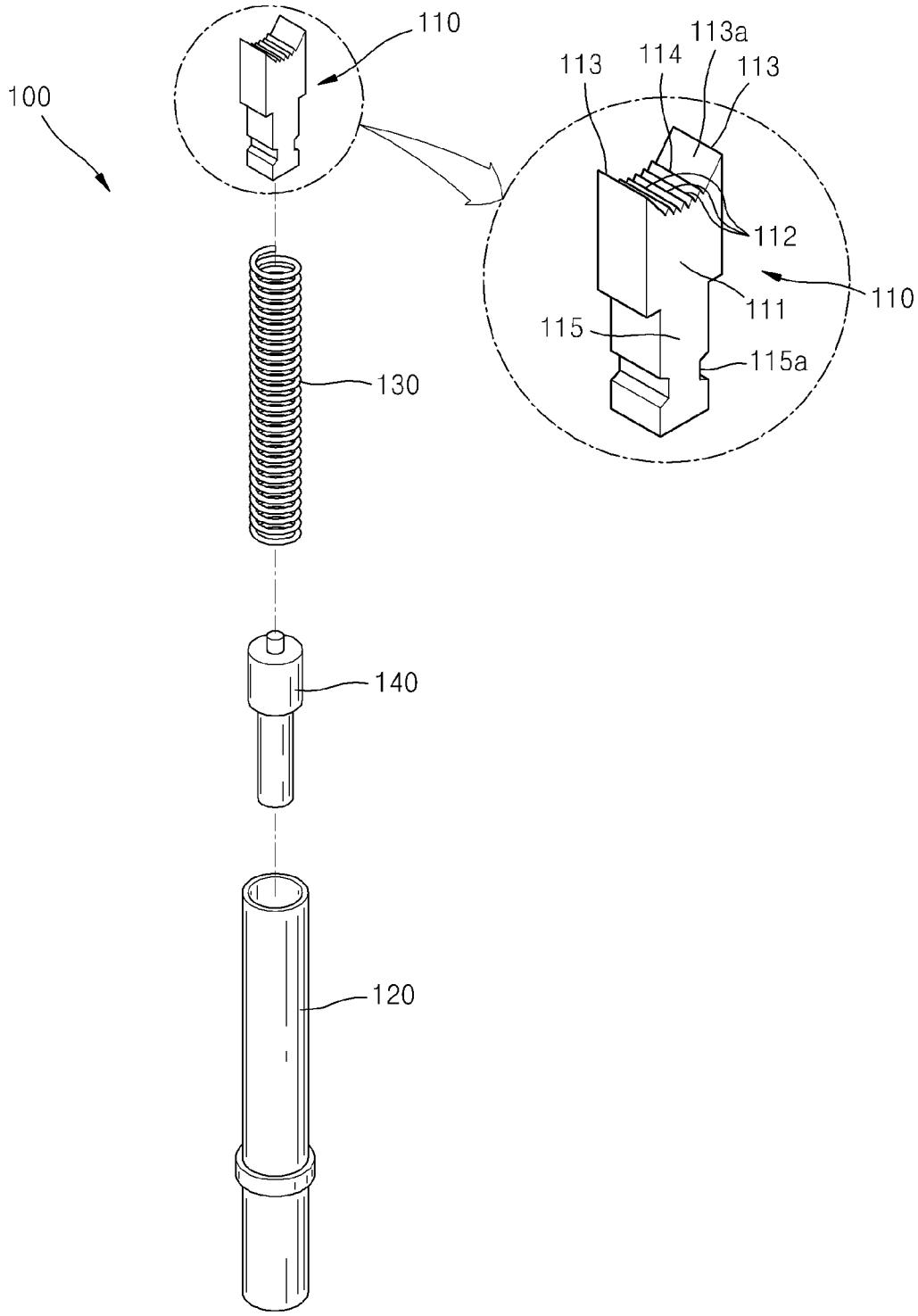


FIG. 7

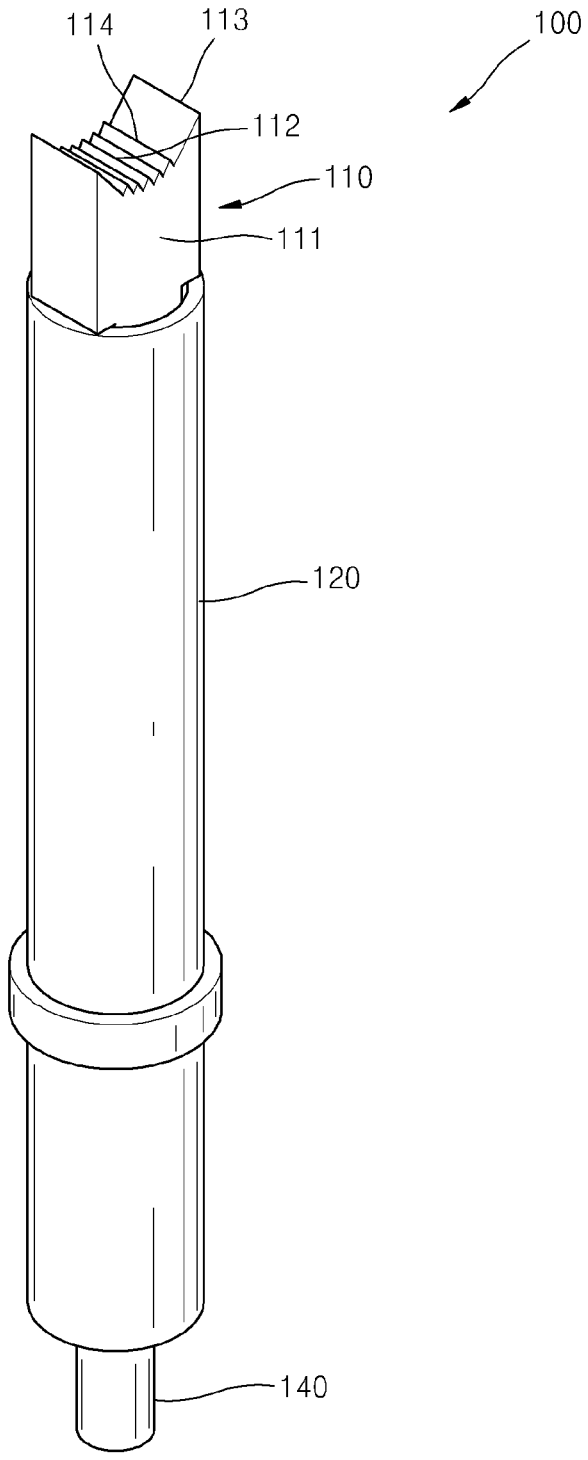


FIG. 8

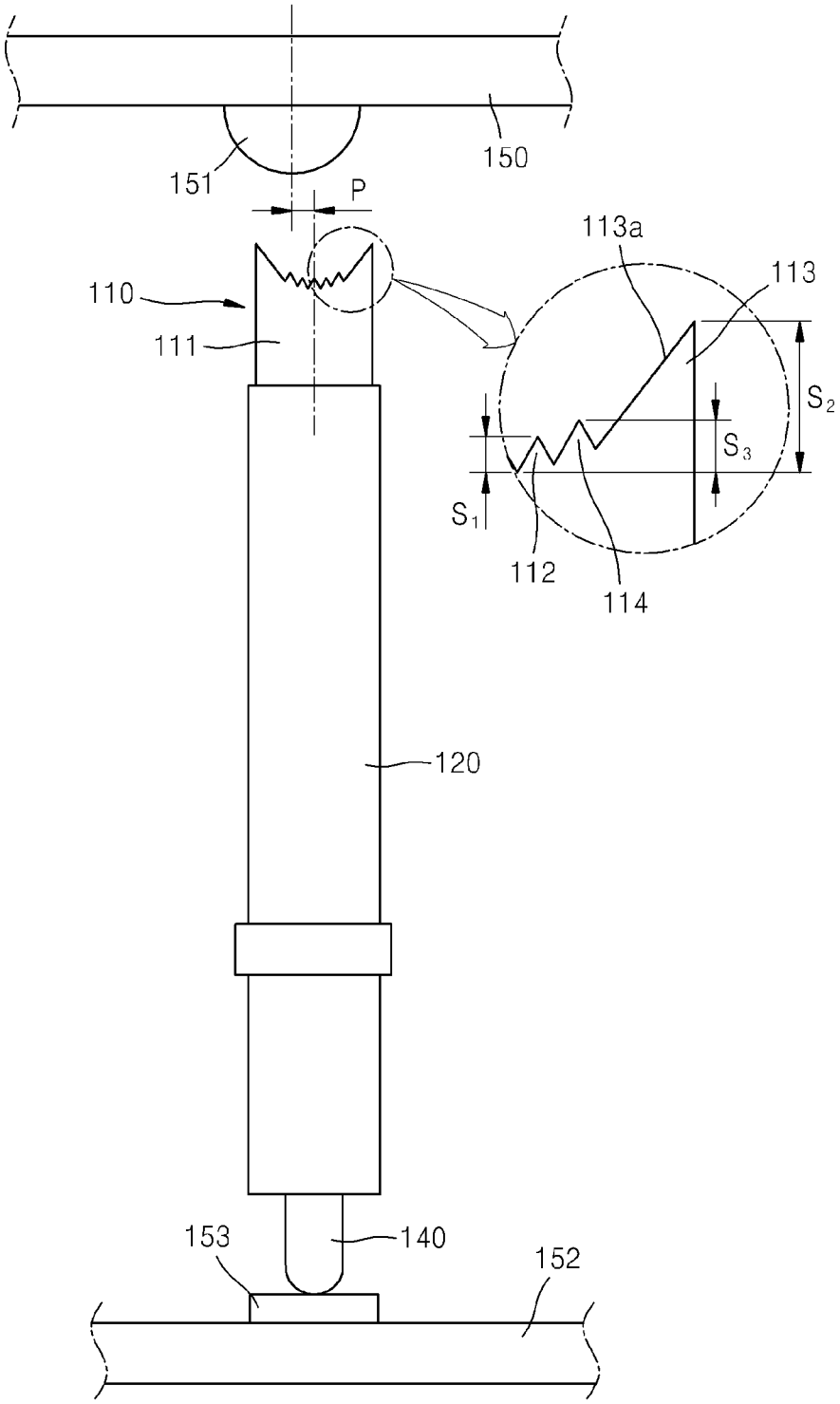


FIG. 9

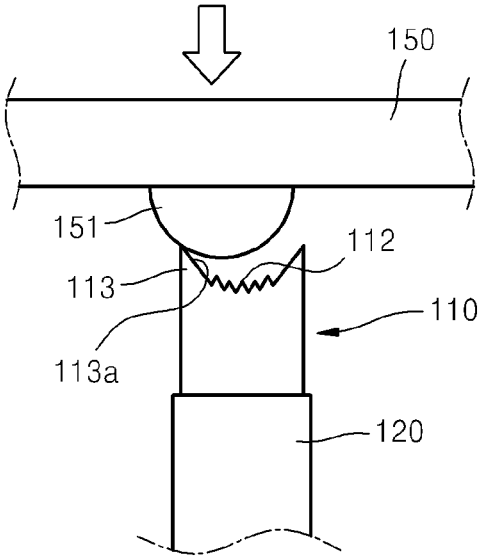


FIG. 10

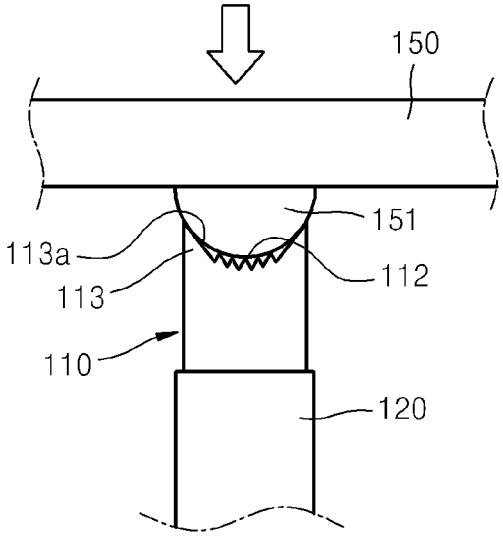


FIG. 11

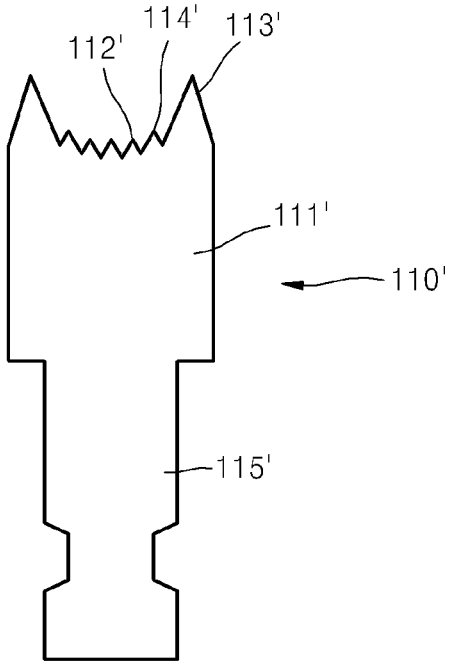
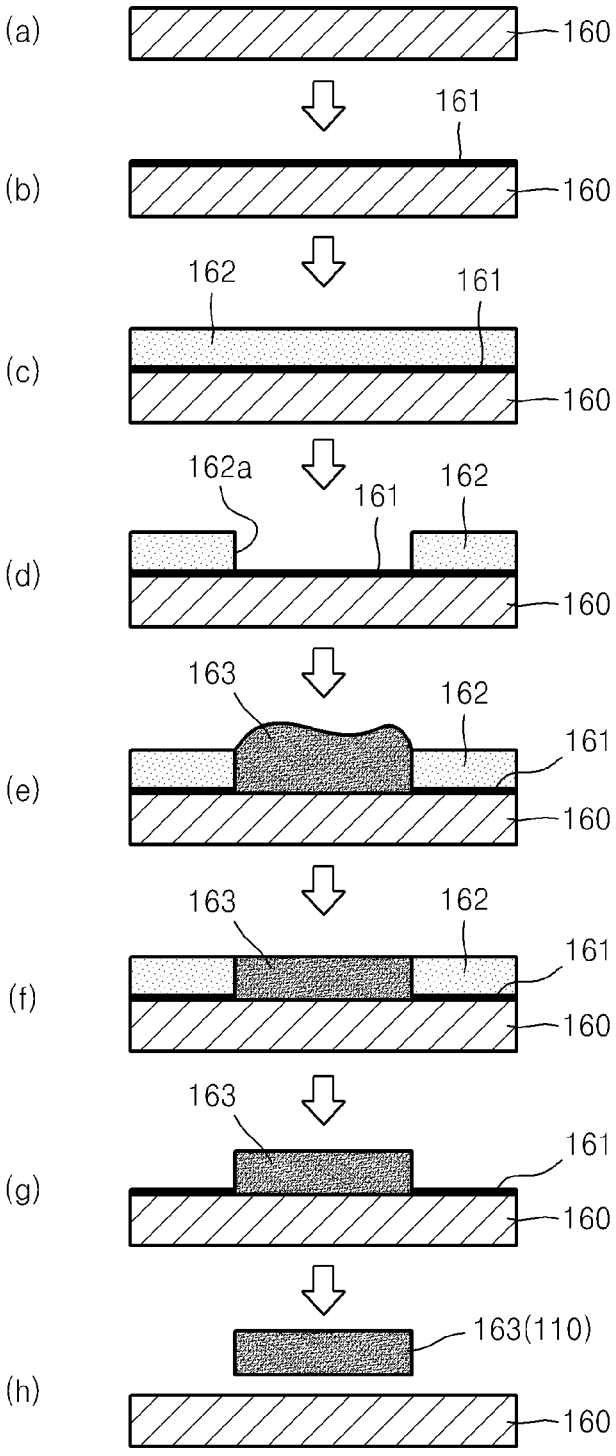


FIG. 12


(a)
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161
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(c)
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162a
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(g)
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163(110)
(h)
160

PROBE MEMBER FOR POGO PIN

RELATED APPLICATION

This application claims the benefit of Korean Patent Application No. 10-2013-0043097, filed on Apr. 18, 2013, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

BACKGROUND

1. Field

One or more embodiments of the present invention relate to a probe member for a pogo pin, and more particularly, to a probe member for a pogo pin that reliably contacts a terminal of a semiconductor device so as to be electrically connected well.

2. Description of the Related Art

Generally, in order to test electrical characteristics of semiconductor devices, a semiconductor device needs to have a stable electrical connection with a test device. Generally, a test socket is used as a device for the connection between the semiconductor device and the test device.

The test socket connects a terminal of the semiconductor device and a pad of the test device so that electrical signals may be exchanged bidirectionally. To this end, a pogo pin is used as a contacting unit in the test socket. The pogo pin includes a spring to easily connect the semiconductor device and the test device and to absorb a mechanical shock which may occur during the connection, and thus, it is used in most test sockets.

FIG. **1** schematically illustrates a general pogo pin.

A semiconductor device **1** that is a tested device includes an external connection terminal **2**, and a test substrate **8** including a substrate pad **9** is disposed to correspond to the external connection terminal **2**. In addition, a pogo pin **3** is located between the semiconductor device **1** and the test substrate **8** to electrically connect the semiconductor device **1** and the test substrate **8** to each other. In FIG. **1**, a body of the test socket is omitted. As shown in FIG. **1**, the pogo pin **3** includes an upper plunger **5** and a lower plunger **6** on opposite ends of a body **4**, and a spring **7** is inserted into the body **4**. Accordingly, the spring **7** applies an elastic force to the upper plunger **5** and the lower plunger **6** in a direction in which the upper and lower plungers **5** and **6** are apart from each other. Here, the upper plunger **5** is connected to the external connection terminal **2** of the semiconductor device **1**, and the lower plunger **6** is connected to the substrate pad **9** of the test substrate **8**. Accordingly, the external connection terminal **2** and the substrate pad **9** are electrically connected to each other. That is, when an end of the upper plunger **5** contacts the external connection terminal **2** of the semiconductor device **1** and an end of the lower plunger **6** contacts the substrate pad **9** of the test substrate **8**, the external connection terminal **2** and the substrate pad **9** are electrically connected to each other.

Another conventional pogo pin is disclosed in Korean Patent Application No. 10-2011-0127010. In particular, FIGS. **2** and **3** illustrate a pogo pin for semiconductor testing that electrically connects a semiconductor device (not shown) to a test substrate (not shown) to test the semiconductor. The pogo pin includes a first plunger **20**, a second plunger **30**, and an elastic member **40**. A movement space penetrated on two sides is formed in the first plunger **20**. The second plunger **30** is formed of a conductive material. Also, the second plunger **30** is inserted into the movement space of the first plunger **20** so that an end of the second plunger **30** selectively protrudes over a contact exit **22'** on a side of the movement space. The

elastic member **40** is inserted between the first plunger **20** and the second plunger **30** to apply an elastic force in a direction in which the first plunger **20** and the second plunger **30** are apart from each other. An end of the second plunger **30** is connected to a substrate pad of the test substrate and the other end of the second plunger **30** is exposed outwards from the contact exit formed on one side of the movement space of the first plunger **20** by a relative movement of the first plunger **20** and the second plunger **30**, to be connected to an external connection terminal of the semiconductor device.

The above-described pogo pins have the following problems.

Generally, the semiconductor device contacts the pogo pin by descending in a state in which the semiconductor device is inserted into a receiving socket. However, it is difficult for the terminal of the semiconductor device to be located at the center of the pogo pin, as the insert descends. In particular, recently, terminals of the semiconductor device tend to have small sizes and narrow distances among one another, and thus, it has become even more difficult for the center of the terminal of the semiconductor device to form an identical axis with the center of the pogo pin, as the semiconductor device descends.

If the terminal **2** of the semiconductor device **1** does not descend by forming an identical axis with the center of the first plunger **20** and descends while being deviated from the center of the first plunger **20** by a predetermined distance P in a horizontal direction, as shown in FIG. **4**, the terminal **2** of the semiconductor device **1** may not reliably contact probe portions of the first plunger **20**, as shown in FIG. **5**. That is, even when the terminal **2** contacts the probe portions, the terminal **2** may not contact a plurality of probes and may contact only a portion of probes so that the contact performance is largely deteriorated.

When the contact between the pogo pin and the terminal of the semiconductor device is not solid, the reliability of a test result of the semiconductor device may become decreased.

PRIOR TECHNICAL REFERENCE

Patent Reference

Korean Patent Application No. 10-2011-0127010

SUMMARY

One or more embodiments of the present invention include a probe member for a pogo pin which enables a solid contact between the pogo pin and a terminal of a semiconductor device even when the terminal of the semiconductor device does not descend at the center of the pogo pin.

Additional aspects will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the presented embodiments.

According to one or more embodiments of the present invention, a probe member for a pogo pin used for testing a semiconductor device, at least a portion of the probe member being inserted into a cylindrical body and supported by an elastic member and an upper end of the probe member contacting a terminal of the semiconductor device, includes: a probe portion, in an upper end of which a plurality of probes contacting the terminal of the semiconductor device are formed; and a combining portion that extends downwards from the probe portion and is inserted into the cylindrical body to be combined with the cylindrical body, wherein the probes include a plurality of first probes arranged at a center

and contacting the terminal of the semiconductor device and a second probe disposed adjacent to the first probes and including a guide surface to guide the terminal of the semiconductor device contacting the second probe toward the first probes.

A protrusion height of the second probe may be greater than a protrusion height of the first probes.

The second probe may be arranged such that a pair of second probes are arranged to face each other with the first probes between the pair of second probes.

The second probe may be disposed in an upper edge of the probe portion.

A third probe which has a protrusion height that is greater than a protrusion height of the first probes and smaller than a protrusion height of the second probe may be arranged between the first probes and the second probe.

The second probe may have a cross-sectional shape of a right triangle.

According to one or more embodiments of the present invention, a probe member for a pogo pin used for testing a semiconductor device, at least a portion of the probe member being inserted into a cylindrical body and an upper end of the probe member contacting a terminal of the semiconductor device, includes: a probe portion, in an upper end of which a plurality of probes contacting the terminal of the semiconductor device are formed; and a combining portion that extends downwards from the probe portion and is inserted into the cylindrical body to be combined with the cylindrical body, wherein the probes include a plurality of first probes arranged at an upper center of the probe portion and contacting the terminal of the semiconductor device and a second probe arranged in an upper edge of the probe portion and having a protrusion height that is greater than a protrusion height of the first probes.

The second probe may be arranged such that a pair of second probes are arranged to face each other with the first probes between the pair of second probes.

A third probe which has a protrusion height that is greater than the protrusion height of the first probes and smaller than the protrusion height of the second probe may be arranged between the first probes and the second probe.

The second probe may have a cross-sectional shape of a right triangle.

BRIEF DESCRIPTION OF THE DRAWINGS

These and/or other aspects will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings in which:

FIG. **1** is a schematic view of a general pogo pin;

FIG. **2** is an exploded perspective view of a general pogo pin;

FIG. **3** is a cross sectional view of FIG. **2**;

FIGS. **4** and **5** are diagrams for explaining operation of a general pogo pin;

FIG. **6** is a perspective view of a pogo pin including a probe member for a pogo pin according to an embodiment of the present invention;

FIG. **7** is a combined perspective view of FIG. **6**;

FIGS. **8** through **10** are diagrams for explaining operation of the pogo pin of FIG. **6**;

FIG. **11** is a view of a probe member for a pogo pin according to another embodiment of the present invention; and

FIG. **12** is a view illustrating a method of manufacturing a probe member for a pogo pin according to embodiments of the present invention.

DETAILED DESCRIPTION

Hereinafter, a probe member for a pogo pin according to an embodiment of the present invention will be described in detail with reference to attached drawings.

The probe member for the pogo pin **110** according to the present embodiment is used for testing a semiconductor device **150**. At least a portion of the probe member for the pogo pin **110** is inserted into a cylindrical body **120** to be supported by an elastic member **130**, and an upper end of the probe member for the pogo pin **110** contacts a terminal **151** of the semiconductor device **150**.

The probe member for the pogo pin **110** is formed of a probe portion **111** and a combining portion **115**.

The probe portion **111** includes a plurality of probes contacting the terminal **151** of the semiconductor device **150**, in an upper end thereof. Here, the probes include first probes **112** and a second probe **113**.

The first probes **112** are arranged at a center of the upper end of the probe portion **111**. The first probes **112** are arranged in a horizontal direction, each of the first probes **112** having substantially the same height. It is desired that each of the first probes **112** have an approximately triangular shape. However, it is not limited thereto, and each of the first probes **112** may have various shapes, such as trapezoidal or quadrangular shapes. The first probes **112** extend in the horizontal direction, each of the first probes **112** having a triangular cross-sectional shape.

The first probes **112** may be formed of a nickel alloy material, which is solid and has excellent electrical conductivity. That is, the first probes **112** may be formed of nickel-cobalt, however, it is not limited thereto. The first probes **112** may be formed of various materials, according to necessity.

The second probe **113** is arranged adjacent to the first probes **112**. The second probe **113** includes a guide surface **113***a* that may guide the terminal **151** of the semiconductor device **150**, which contacts the second probe **113**, toward the first probes **112**. The guide surface **113***a* may have a slope shape tapered toward the first probes **112**.

Here, a protrusion height s**2** of the second probe **113** is greater than a protrusion height s**1** of the first probes **112**. Also, the second probe **113** may be arranged such that a pair of second probes **113** are disposed to face each other with the first probes **112** therebetween. The pair of second probes **113** are arranged in an upper edge of the probe portion **111**.

The second probes **113** may have a cross-sectional shape of a right triangle since the guide surface **113***a* that is sloped is arranged to face the first probes **112** and the exterior surface has a vertical shape. The second probes **113** are extended in a horizontal direction. That is, the second probes **113** are extended in the same direction as the first probes **112**.

Meanwhile, a third probe **114** having a protrusion height s**3** which is greater than the protrusion height s1 of the first probes **112** and smaller than the protrusion height s**2** of the second probe **113**, may be disposed between the first probes **112** and the second probe **113**.

The combining portion **115** extends downwards from the probe portion **111** and is inserted into the cylindrical body **120** to be combined with the cylindrical body **120**.

The combining portion **115** includes a concave portion **115***a* which is concave toward the inside, and, a portion of the cylindrical body **120** is retracted toward the inside in corre-

spondence to the concave portion **115***a* so as to fixedly combine the combining portion **115** to the cylindrical body **120**.

Meanwhile, a structure of a pogo pin **100** including the probe member for the pogo pin **110** according to the present embodiment is as described below. The pogo pin **100** includes the probe member for the pogo pin **110**, the cylindrical body **120**, an elastic member **130** disposed inside the cylindrical body **120** and elastically biasing the probe member for the pogo pin **110** toward an upper side, and a lower probe member **110**, at least a portion of which protrudes through a lower opening of the cylindrical body **120** and which is supported by the elastic member **130**. Here, the pogo pin **100** is inserted into a housing (not shown) including openings in upward and downward directions.

An operational effect of the probe member for the pogo pin **100** according to the present embodiment will now be described.

First, when the terminal **151** of the semiconductor device **150** descends in a state in which the center of the terminal **151** of the semiconductor device **150** does not correspond to the center of the probe member for the pogo pin **110**, deviating from the center of the probe member for the pogo pin **110** in a horizontal direction, as shown in FIG. **8**, the terminal **151** of the semiconductor device **150** first contacts the second probe **113**, as shown in FIG. **9**. Here, when the terminal **151** of the semiconductor device **150** further descends, the terminal **151** of the semiconductor device **150** is guided toward the center of the probe portion **111** along the guide surface **113***a* of the second probe **113**, and, accordingly, the terminal **151** of the semiconductor device **150** may reliably contact the first probes **112** disposed at the upper center of the probe portion **111**, as shown in FIG. **10**. Here, the first probes **112** include a plurality of projections so that the terminals **151** of the semiconductor device **150** reliably contact the plurality of probes.

As described above, according to the probe member for the pogo pin **110** according to the present embodiment, the terminal **151** of the semiconductor device **150** is guided toward the center of the pogo pin **100** to contact the plurality of first probes **112**, even when the terminal **151** of the semiconductor device **150** descends in a state in which the terminal **151** of the semiconductor device **150** deviates from the center of the pogo pin **100** in the horizontal direction. Thus, the terminal **151** of the semiconductor device **150** may reliably contact a plurality of contact points, thereby ensuring the reliability of the test.

The probe member for the pogo pin **110** according to the present embodiment may be manufactured as illustrated in FIG. **12**.

First, a substrate **160** formed of a silicon material is prepared, as illustrated in FIG. **12**A. A conductive layer **161** is formed on an upper surface of the substrate **160**, as illustrated in FIG. **12**B. A dry film **162** is disposed on the conductive layer **161**, as illustrated in FIG. **12**C. A predetermined groove **162***a* is formed in the dry film **162**, as illustrated in FIG. **12**D. Here, the groove **162***a* has a shape corresponding to a shape of the probe member for the pogo pin **110** that is being manufactured. Next, a plating layer **163** is formed by adopting a plating material in the groove **162***a* formed by the dry film **162**, as illustrated in FIG. **12**E. Then, a planarization operation is performed as illustrated in FIG. **12**F. After that, the dry film **162** formed on the substrate **160** is removed, as illustrated in FIG. **12**G. Finally, the probe member **110** that is manufactured is removed from the substrate **160**, as illustrated in FIG. **12**H.

The probe member for the pogo pin **110** is not limited to the above described shape, and may be realized having various shapes. In particular, a second probe **113'** disposed around first probes **112'** may be formed to have a shape of an isosceles triangle, instead of the right triangle.

As described above, according to the one or more of the above embodiments of the present invention, the probe member for the pogo pin includes the second probe that guides the terminal of the semiconductor device descending around the first probes arranged in the center of the probe portion, toward the first probes. Therefore, the terminal of the semiconductor device may reliably contact the pogo pin.

It should be understood that the exemplary embodiments described herein should be considered in a descriptive sense only and not for purposes of limitation. Descriptions of features or aspects within each embodiment should typically be considered as available for other similar features or aspects in other embodiments.

While one or more embodiments of the present invention have been described with reference to the figures, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

What is claimed is:

1. A probe member for a pogo pin used for testing a semiconductor device, with a first end and at least part of a middle portion of the probe member telescopically cooperating with a cylindrical body and supported by an elastic member, and an upper second end of the probe member for contacting a terminal of the semiconductor device to be tested, the probe member comprising:

an elongate body having a first end, a spaced apart second end and a middle portion aligned along an common axis;

wherein the upper second end of the elongate body is provided with a plurality of first projections adjacent the axis for contacting the terminal of the semiconductor device to be tested and a plurality of second projections located radially outboard of the first projections and spaced about the axis; and

wherein the plurality of first projections provide contact with the terminal of the semiconductor device during testing and the second projections have an inwardly sloped guide surfaces to guide the terminal of the semiconductor device toward the first projections during installation.

2. The probe member of claim **1**, wherein a protrusion height of the second projections is greater than a protrusion height of the first projections.

3. The probe member of claim **1**, wherein the second projections are arranged such that a pair of second projections are arranged to face each other with the first projections between the pair of second projections.

4. The probe member of claim **1**, wherein the second projections are disposed in an upper edge of the elongate body first end.

5. The probe member of claim **2**, wherein a third projection which has a protrusion height that is greater than a protrusion height of the first projections and smaller than a protrusion height of the second projections is arranged between the first projections and the second projections.

6. The probe member of claim **1**, wherein the second projections has a cross-sectional shape of a right triangle.

7. A probe member for a pogo pin used for testing a semiconductor device, at least a portion of the probe member being inserted into a cylindrical body and an upper end of the probe member contacting a terminal of the semiconductor device, the probe member comprising:

a probe portion, in an upper end of which a plurality of probes contacting the terminal of the semiconductor device are formed; and

a combining portion that extends downwards from the probe portion and is inserted into the cylindrical body to be combined with the cylindrical body,

wherein the probes comprise a plurality of first probes arranged at an upper center of the probe portion and contacting the terminal of the semiconductor device and a second probe arranged in an upper edge of the probe portion and having a protrusion height that is greater than a protrusion height of the first probes.

8. The probe member of claim **7**, wherein the second probe is arranged such that a pair of second probes are arranged to face each other with the first probes between the pair of second probes.

9. The probe member of claim **7**, wherein a third probe which has a protrusion height that is greater than the protrusion height of the first probes and smaller than the protrusion height of the second probe is arranged between the first probes and the second probe.

10. The probe member of claim **7**, wherein the second probe has a cross-sectional shape of a right triangle.

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